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NATIONAL DAM SAFETY PROGRAM. PERRY COUNTY SPORTSMAN'S CLUB LAKE--ETC(U)
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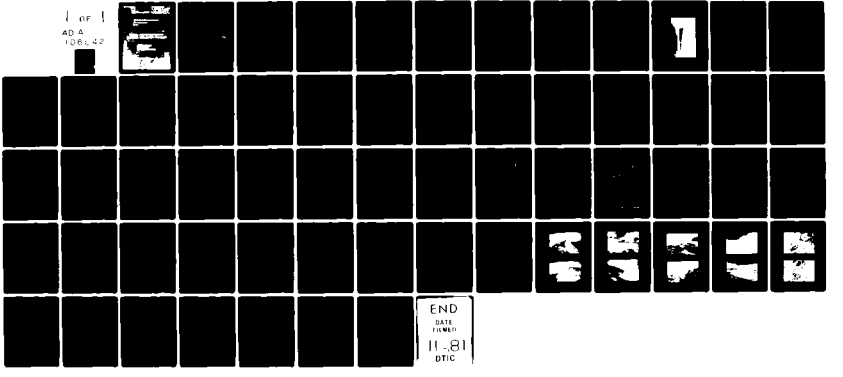

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.	

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MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

PERRY COUNTY SPORTSMAN'S CLUB LAKE DAM

PERRY COUNTY, MISSOURI

MO 31097

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MARCH 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Perry County Sportsman's Club Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Perry County Sportsman's Club Lake Dam (MO 51097).

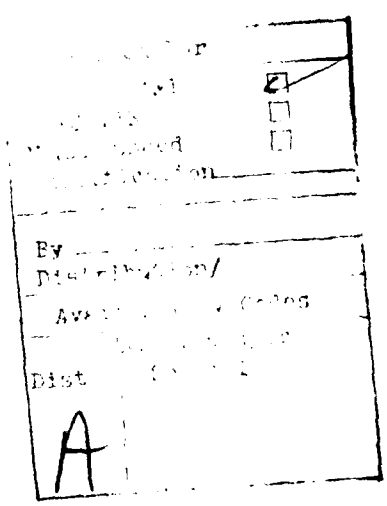
It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division
9 APR 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
10 APR 1980
Date



PERRY COUNTY SPORTSMAN'S CLUB LAKE DAM

MISSOURI INVENTORY NO. 31097

PERRY COUNTY, MISSOURI

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.
5200 OAKLAND AVENUE
ST. LOUIS, MISSOURI 63110

FOR:

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

MARCH 1980

HS-7925

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Perry Co. Sportsman's Club Lake Dam
State Located:	Missouri
County Located:	Perry
Stream:	Tributary Whitewater River
Date of Inspection:	4 October 1979

The Perry Co. Sportsman's Club Lake Dam, was visually inspected by engineering personnel of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of this inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses any hazard to human life or property.

The following summarizes the findings of the visual inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team. Based on the visual inspection and the results of these hydrologic/hydraulic investigations, the present general condition of the dam is considered to be somewhat less than satisfactory. The following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam:

1. The upstream face of the embankment has a sparse cover of grass to protect the slope from erosion. A grass covered slope is not considered adequate to prevent erosion by wave action or by fluctuations of the lake level.
2. With the exception of the crest area of the emergency spillway which for the most part is covered with grass, the earthen

sections of the principal and auxiliary spillway channels have no form of protection to prevent erosion. Earthen areas of spillways should be protected by grass to prevent erosion by lake outflow.

3. At the time of the inspection the plant cover on the crest and downstream face of the dam was approximately 3 feet high. Uncut grass on the dam is an indication of lack of regular maintenance.

According to a representative of the Owner, since construction of the dam, the lake has experienced problems with excessive leakage, as manifested by the inability to maintain a stable lake surface level. At the time of the inspection flow was observed emerging at two locations in the general area of the downstream channel approximately 600 feet below the dam. It was reported that these springs, each of which was flowing at a rate of about 5 gpm, did not exist prior to construction of the dam and that they are not perennial. Within the scope of the investigation procedures prescribed in the guidelines, it is not possible to conclude if the leakage that is presently occurring poses a hazard to the safety of the dam, the location(s) of which is unknown. The leakage is however, an impediment to the satisfactory operation of the lake.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Perry Co. Sportsman's Club Lake Dam, which is classified as small in size and of high hazard potential, is specified to be a minimum of one-half the Probable Maximum Flood (PMF). Considering the fact that a fairly large volume of water is impounded; the downstream floodplain is relatively narrow and flow in the stream will be deep and with high velocities; and that several dwellings and a county road lie within the possible flood damage zone, it is recommended that the spillway for this dam be designed for the PMF. The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic

conditions that are reasonable possible in the region. The PMF is ordinarily accepted as the inflow design flood for dam. Dam failure of the structure would increase the danger to human life.

Results of a hydrologic/hydraulic analysis indicated that the existing spillways are inadequate to pass lake outflow resulting from a storm of PMF magnitude. The principal spillway is adequate to pass the lake outflow resulting from a the 1 percent chance (100-year frequency) flood. Both spillways, principal plus emergency, are capable of passing lake outflow corresponding to about 14 percent of the PMF lake inflow. According to the St. Louis District, Corps of Engineers, the length of the downstream damage zone, should failure of the dam occur, is estimated to be four miles. Accordingly, within the possible damage zone are County Highway BB, three dwellings, and several associated out buildings.

A review of available data did not disclose that seepage or stability analyses of this dam were performed. This is considered a deficiency and should be rectified.

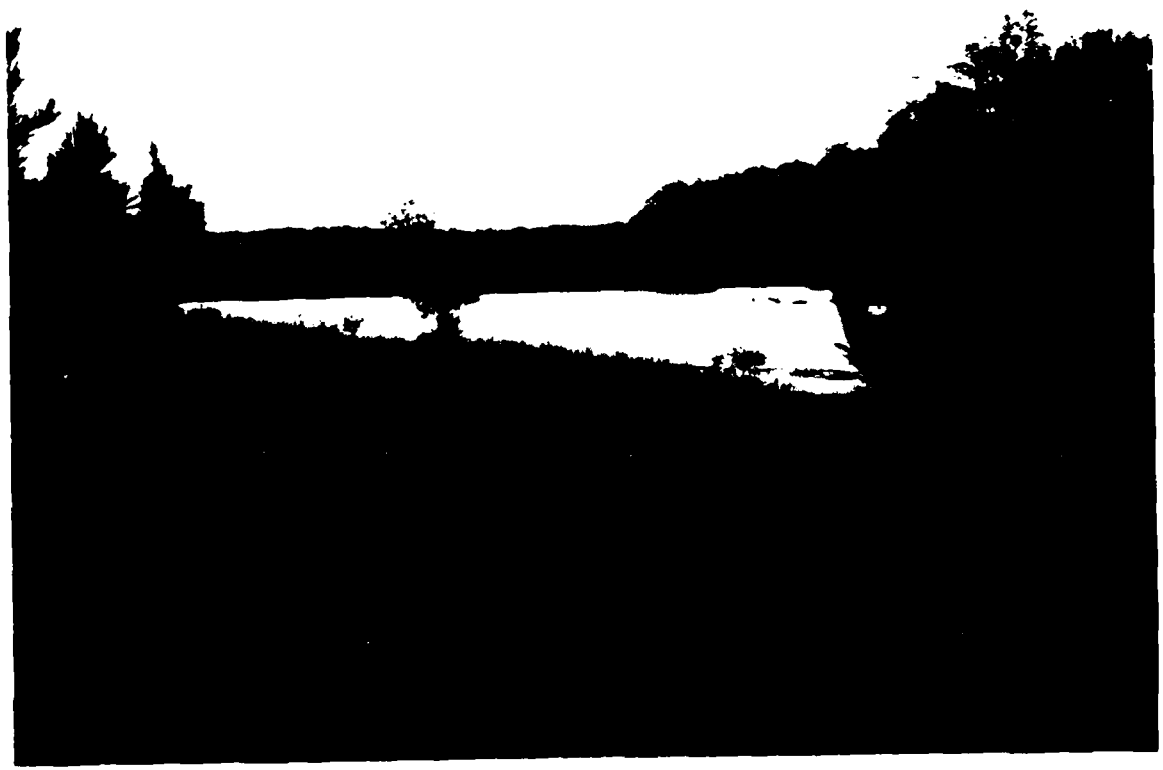
It is recommended that the Owner take the necessary action within a reasonable period of time to correct or control the deficiencies and safety defects reported herein.

Harold B. Lockett

P.E. Missouri E-4180

Albert B. Becker, Jr.

P.E. Missouri E-9168



OVERVIEW PERRY CO. SPORTSMAN'S CLUB LAKE DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PERRY COUNTY SPORTSMAN'S CLUB LAKE DAM - I.D. NO. PA 01017

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2-1, 2-2	Engineering Geologic Report on Spotsman's Lamb Lake Site, Perry County, Missouri, by James D. Williams, Chief Geologist, Missouri Geological Survey, August 11, 1971.

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PHASE I [illegible]
NATIONAL DAM [illegible] PROGRAM

PERRY CO. SPORTSMAN'S [illegible]
MISSOURI [illegible]

SECTION 1 - [illegible]

1.1 GENERAL

a. Authority. The National Dam Inspection Act, [illegible], dated 8 August 1972, authorized the Secretary of the Army, acting through the Corps of Engineers, to initiate a program of dam safety inspections throughout the United States. Pursuant to this Act, the [illegible] District, Corps of Engineers, directed that a [illegible] Perry Co. Sportsman's Club Lake Dam be made.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general condition of the dam with respect to safety and, based upon available data and this one inspection, to classify the dam with respect to urgency and magnitude of remedial measures that should be undertaken.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as presented in the "Recommended Guidelines for Safety Inspection of Dams," Appendix D to Civil Works Engineer Bulletin 75-5, Office, Chief of Engineers, the National Program of Inspection of Non-Federal Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Perry Co. Sportsman's Club Lake Dam is an earthfill type embankment [illegible] approximately 34 feet above the original stream bed. The embankment has an upstream slope (above the waterline) of 1v on 2h, a crest width of about 12 feet, and a

downstream slope of the dam. The length of the dam including the spillway sections is approximately 650 feet. A plan and profile of the dam are shown on Plate 2 and a cross section of the dam is shown on Plate 3. At normal pool elevation the reservoir impounded by the dam, occupies approximately 17 acres.

The principal spillway, a nearly trapezoidal, broad-crested, earth and rock section, is cut into the hillside at the north or right abutment. The spillway crest has been excavated to rock and has a width of about 9 feet, confined on the left by an improved, earth berm approximately 20 feet wide and 4 feet high, and on the right by the steep, unprotected earth hillside. Below the crest the spillway channel consists of a succession of uneven rock ledges with short, steep outwash. At a point approximately 300 feet from the crest spillway flow is directed into a natural draw that joins the downstream channel, an unnamed tributary of Whitewater River. The Whitewater River is located approximately 3,300 feet below the dam.

The emergency spillway, a nearly trapezoidal, broad-crested, earth section is cut into the hillside at the left or north abutment. The section has a flat bottom about 47 feet wide and is confined on the left by the unprotected earth hillside and on the right by a narrow, unprotected earth berm approximately 2 feet high. Spillway flow is directed away from the dam across the remnant of an old borrow area and toward the downstream channel.

b. Location. The dam and lake are located on an unnamed tributary of Whitewater River, approximately 6 miles northwest of Perryville, Missouri, as shown on the Regional Vicinity Map, Plate 1. The dam is located in Section 14, Township 34 North, Range 8 East, in Perry County.

c. Size Classification. The size classification based on the height of the dam and storage capacity, is categorized as small. (See Table 1, Recommended Guidelines for Safety Inspection of Dams.)

d. Flood Characterization. The [illegible] Lake Dam, according to the St. Louis District, Corps of Engineers, has a high hazard potential. Failure of the dam would, it is estimated, probably result in the loss of life, serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The estimated flood damage zone, as determined by the St. Louis District, Corps of Engineers, extends [illegible] downstream of the dam. Within the potential flood zone are County Highway BE, three dwellings, and several [illegible] buildings.

e. Ownership. The lake and dam are owned by the Perry County Sportsman' Club, Incorporated, a Missouri corporation, of which Mr. Albert Buchholt is the current president. Mr. Buchholt's address is: 1106 Rand, Perryville, Missouri 63775.

f. Purpose of Dam. The dam impounds water for recreational use by individuals who are members of the club.

g. Design and Construction History. According to a representative of the Owner, the dam was constructed in 1971 by the Obert Brothers Excavating and Grading Company of Perryville, Missouri. According to both a representative of the Owner and Mr. Norbert Obert, President of Obert Brothers, the dam was constructed without the benefit of formal engineering design data or plans.

According to a representative of the Owner, a second seepage cutoff (it was reported that a core wall was installed when the dam was constructed in 1971) was installed along the upstream side of the dam in about 1976, and that the work was done by Joe Dippold, a local excavating contractor.

h. Normal Operational Procedure. The lake level is unregulated.

1.3 [illegible] DATA

a. Drainage Area. The area tributary to the lake is primarily undeveloped and in a native state covered with timber. The watershed above the dam amounts to approximately 461 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 70 cfs*

(2) Spillway capacity (principal) ... 215 cfs (W.S. = Elev. 836.8)

(3) Spillway capacity (principal + emergency) ... 1,057 cfs (W.S. = Elev. 838.5)

c. Elevation (Ft. above MSL). The following elevations were determined by survey and are based on topographic data shown on the 1939 USGS Parker Lake, Missouri Quadrangle Map, 7.5 Minute Series.

(1) Top of dam ... 838.8 (min.)

(2) Normal pool (spillway crest) ... 831.0

(3) Streambed at centerline of dam ... 809±

(4) Maximum tailwater ... Unknown

d. Reservoir.

(1) Length at normal pool (elevation 834.0) ... 1,900 ft.

(2) Length at maximum pool (elevation 836.3) ... 2,100 ft.

e. Storage.

(1) Normal pool ... 142 ac. ft.

(2) Top of dam (Incremental) ... 97 ac. ft.

f. Reservoir Surface.

(1) Normal Pool ... 17 acres

(2) Top of Dam (Incremental) ... 7 acres

*Based on an estimate of depth of flow as observed by a representative of the Owner.

a. Dam.

(1) Type ... Earthfill, homogeneous*

(2) Length ... 660 ft.

(3) Height ... 34 ft.

(4) Top width ... 12 ft.

(5) Side slopes

a. Upstream ... 1v on 3h

b. Downstream ... 1v on 2h

(6) Cutoff ... Clay core*

(7) Slope protection

a. Upstream ... Grass

b. Downstream ... Grass

b. Principal Spillway.

(1) Type ... Uncontrolled, trapezoidal, broad-crested earth and rock section

(2) Crest elevation ... 834.0

(3) Approach channel ... Lake

(4) Exit channel ... Earth cut, trapezoidal section

c. Emergency Spillway.

(1) Type ... Uncontrolled, trapezoidal, broad-crested earth section

(2) Crest ... Elevation 836.3

(3) Approach channel ... Lake

(4) Exit channel ... No defined section

d. Lake Drawdown Facility. ... None

*Per builder of dam.

2.1 DESIGN

No engineering data relating to the design of the dam are known to exist.

2.2 CONSTRUCTION

No formal records were maintained during construction of the dam. According to Mr. Stortz, Secretary of the Club, M. Nelson, a club member, and Mr. Geisler, the contractor who built the dam, a core trench 10-to-12 feet wide was excavated along the centerline of the dam to the weathered clay-seamed surface of bedrock. It was reported, however, that excavation was terminated at a depth at which a bulldozer working in the trench could no longer dislodge boulders and was not carried to sound rock throughout. The material used to backfill the trench and construct the embankment, a stoney red clay, was obtained from the area to be occupied by the lake and from a borrow area directly downstream of the north abutment. The contractor recalled that compaction of the fill was obtained using rubber-tired equipment.

2.3 OPERATION

The lake level is uncontrolled and governed by the crest elevation of the principal spillway located at the right abutment. An emergency spillway, with a crest elevation approximately 2.0 feet higher than the crest elevation of the principal spillway and about 2.0 feet lower than the top of the dam at its lowest point, is located at the left abutment. A representative of the Owner reported that the dam had never been overtopped and that the highest lake level observed to date produced a depth of flow at the principal spillway estimated to be about 1.5 feet.

An engineering geologic report on the [illegible] dated August 11, 1971, reference Sheets 2-1 and 2-2, was prepared by Mr. James H. Williams, Chief Geologist, Missouri Geological Survey. It appears, based on the contents of the report, that Mr. Williams investigated the site after the dam was completed and the reservoir was experiencing excessive leakage.

In the report, Mr. Williams states that the site is considered to be geologically poor due to the fact that the reservoir area is predominantly composed of a moderately to highly permeable gravelly silt, negating the probability of the reservoir to retain water.

Mr. Williams recommends that prior to attempting any remedial work to seal the reservoir, that a thorough investigation be made of the dam foundation and existing conditions. The report recommends a method of exploring the characteristics of the foundation as well as an assessment of the possible findings of such an investigation. The report also recommends that the reservoir area be explored in order to determine the characteristics of the subsoil.

In conclusion, Mr. Williams recommends that if the leakage is occurring throughout the reservoir, the only possible way to seal the lake is to pad the floor of the reservoir with 2 feet, or more of earth. It is also stated that such a procedure is not only costly but has only a limited chance of success.

2.4 EVALUATION

a. Availability. Engineering data for assessing the design of the dam and spillways were unavailable.

b. Adequacy. No data available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for

appropriate loading conditions (including earthquake loads) and make a matter of record.

3.1 FINDINGS

a. General. A visual inspection of the Perry Co. Sportsman's Club Lake Dam was made by Horner & Shifrin engineering personnel, W.B. Beckett, Civil Engineer and Hydrologist, T.E. Dennis, Geologist Engineer, and A.S. Becker, Jr., Civil and Soils Engineer, on 4 October 1979. An examination of the dam site was also made by an engineering geologist, Jerry D. Algermissen, a consultant retained by Horner & Shifrin for the purpose of assessing the area geology. Also examined at the time of the inspection, was the area below the dam within the potential flood damage zone. Photographs of the dam taken at the time of the inspection are included on Pages A-1 through A-5 of Appendix A. The locations of the inspection photographs are indicated on Plate 2.

b. Area Geology. The dam site is located on the eastern flank of the Ozark Uplift on gently dipping Ordovician-age sedimentary rock. The Gasconade formation, exposed at the surface in the area of the dam site, is composed primarily of a light brown, cherty, oolitic and chert dolomite with a few thin, irregular sandstone lenses. Stromatolitic, cellular and lacy cherts are a common characteristic of the Gasconade formation.

Intense solution weathering of the bedrock has left a thick residuum covering a very irregular bedrock surface. The residuum, a remnant of the overlaying Roubidoux formation, composed of a red, cherty clay and chert having been derived from the Gasconade outcrops on hills in this area, tends to be relatively permeable and susceptible to erosion.

The left abutment formed by Gasconade cherty clay residuum has experienced some minor erosion. However, it appears stable with no seepage evident at the toe or from the hillside immediately downstream.

The right abutment is formed by thick Boulidoux cherty clay residuum, overlying imbedded chert reefs and dolomite. Bedrock has been exposed in the spillway cut and the abutment adjacent to the spillway. The spillway has been eroded to bedrock and in some places erosion has undercut the hillside slope resulting in small slumps.

No adverse geologic factors which would influence the performance of the dam or reservoir other than the erosion of the spillway channel were noted.

c. Dam. The visible portions of the upstream and downstream faces of the dam (see Photos 1 and 2) appeared to be in sound condition, although erosion of the unprotected upstream slope had created a vertical face of about 6 to 12 inches high at the normal lake level waterline. Plant cover on the upstream and downstream faces of the dam was approximately 3 feet high at the time of the inspection, whereas the grass cover on the dam crest was about 6 inches high. No cracking of the surface or misalignment of the dam crest was noticed.

Both the right and left abutments through the areas where the spillways are located had virtually no plant cover or other form of protection to prevent erosion.

Seepage was observed emerging from two areas (springs) approximately 1,000 feet downstream of the dam. One of these springs was in line with the right side or abutment of the dam, whereas the other appeared to be more in line with the center of the dam. The spring on the right was characterized by soft ground and standing and running water (see Photo 9) which was estimated to be flowing at a rate of about 2 to 3 gpm. At the spring downstream of the center of the dam, a shallow pool, approximately 1 foot deep and 5 feet in diameter, was observed. Water leaving the pool (see Photo 10) was estimated to be flowing at a rate of about 5 to 8 gpm. Flow from both springs was clear and no sediment deposits were noticed in the stream bed. Mr. Herbert Nelson, a club member who was familiar with the area prior to construction of the dam, stated that

these springs appeared shortly after construction of the dam and are perennial.

Judging by the eroded condition of the principal spillway (see Photos 3 and 4) the rock ledges at the spillway crest have been undercut up to several feet and minor sloughing of the right bank (abutment) was evident, it is apparent that this spillway has experienced considerable flow. In addition, erosion of the channel bottom (see Photo 5) below the spillway crest has exposed bedrock ledges which are jagged and uneven. The sides of the channel (see Photos 4 and 6) were unprotected and some erosion of these earthen slopes was noticed. The channel downstream of the junction with the natural draw (see Photo 6) is unimproved and was found to be congested with small trees and dense brush.

The emergency spillway appeared to be in sound condition, although some minor erosion of the unprotected left side and bottom area downstream of the crest (see Photo 7) was observed. The outlet channel for this spillway is not discernible but it was apparent that flow leaving the spillway would follow a course through an old borrow area (see Photo 8) that lies downstream of the dam. The borrow area was sparsely covered with grass and some minor erosion, particularly of the steeper side slopes, was noticed.

d. Downstream Channel. The channel downstream of the dam is unimproved and extends approximately 3,300 feet before joining the Whitewater River. At a distance of about 5 500 feet from the dam, a concrete low-water bridge crosses the Whitewater River providing access to Thompson Hollow. Three 24-inch corrugated metal pipes are provided at the bridge for service flow.

e. Reservoir. The area adjacent to the lake is for the most part in a natural state and wooded. The lake water surface elevation at the time of the inspection was about 7 feet below normal pool, leaving considerable length of shoreline exposed and without plant cover. The

amount of sediment within the lake could not be determined at the time of the inspection, however it is believed not to be significant.

3.2 EVALUATION

With the exception of the lack of protection to prevent erosion of the principal spillway, the deficiencies observed during the inspection and noted herein, are not considered significant to warrant immediate remedial action.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillways are uncontrolled. The water surface level is governed by precipitation runoff, evaporation, seepage, and the capacity of the uncontrolled principal and emergency spillways.

4.2 MAINTENANCE OF DAM

The crest of the dam appeared to have been recently mowed as grass on the crest was only about 4 inches high. The downstream face was grass covered that was approximately 3 feet high at the time of the inspection. However, it was free of trees and brush. As previously indicated, both spillways have experienced erosion and with the exception of some grass cover at the emergency spillways, are unprotected. The disturbed areas of the hillside of the right abutment was also without plant cover to prevent erosion.

According to a representative of the Owner, about 1976 in an attempt to prevent excessive leakage under the dam, a trench was excavated along the toe of the upstream face of the dam between abutments and backfilled with clay. However, it was reported that the excavation did not extend to sound rock throughout, but only to a depth where a dozer working in the trench could no longer remove large boulders and ledge rock. Judging by the inability of the reservoir to sustain a normal level, it appears that this most recent seepage cutoff had little affect in preventing loss of water from the lake. It was also reported that the principal spillway was lowered to rock at this time.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

No outlet operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

The inspection did not reveal the existence of a dam warning system.

4.5 EVALUATION

Considering the efforts made to prevent loss of lake water beneath the dam, it is recognized that members of the club are interested in maintaining the dam as well as promoting a successful operation. To this end, it is recommended that maintenance of the dam and spillways be performed on a regular basis and that records be kept of all maintenance work performed. In any event, it is recommended that the spillways be protected to prevent erosion.

[illegible] EVALUATION OF STRUCTURES

a. Design Data. Design data not available.

b. Experience Data. The drainage area and lake surface area were determined from the USGS Warsaw and Parker Lake, Missouri, Quadrangle Maps. The proportions and dimensions of the spillways and dam were developed from surveys made during the inspection.

c. Visual Observations.

(1) The principal spillway consists of a nearly trapezoidal, broad-crested earth and rock cut having a bottom width of approximately 4 feet and side slopes of about 1 on 1.5h.

(2) The principal spillway has been cut into the hillside at the right (south) abutment.

(3) A berm approximately 2½ feet wide and 4 feet high at the invert of the principal spillway serves to confine flow to the channel and protect the embankment. Spillway releases confined to the channel will not endanger the embankment since flow is conducted away from the dam.

(4) Erosion has undercut rock ledges and resulted in minor sloughing of the hillside along the right bank of the spillway channel.

(5) An emergency spillway, a nearly trapezoidal broad-crested earth section, is cut into the hillside at the left (north) abutment. The section is approximately 40 feet wide and 2 feet deep. The channel is confined on the right by a narrow earth berm and on the left by the unprotected residuum of the hillside face.

(6) No lake drawdown facilities are provided.

d. Overtopping Potential. The spillways (principal and emergency) are inadequate to pass the probable maximum flood or 1/2 the probable

maximum flood without overtopping the dam. They are adequate, that is, to pass the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of a dam overtopping analysis are as follows:

Ratio of PMF	Q-Peak Outflows (cfs)	Max. Lake W.S. Elev.	Maximum Depth of Flow over Dam (Elev. 838.8)	Duration of Overtopping of Dam (Hr.)
0.24	1,077	838.8	0.0	0.
0.50	2,933	840.4	1.6	1.5
1.00	7,002	841.7	2.9	5.3
100-Yr. Flood	665	838.1	0.0	0.0

Elevation 838.8 was found to be the lowest point in the dam crest. The flow safely passing the spillways just prior to overtopping was determined to be approximately 1,077 cfs, which amounts to about 24 percent of the probable maximum flood inflow. This flow is greater than the outflow from the 1 percent chance (100-year frequency) flood. During peak flow of the probable maximum flood, the greatest depth of flow over the dam is projected to be 2.9 feet and overtopping will extend the entire length of the dam crest.

e. Evaluation. Experience indicates that the residuum, a red cherty clay, can under certain conditions, such as high velocity flow, be very erodible. Evidence of such erosion was observed at the principal spillway. For the PMF, when large lake outflow with corresponding high velocities occur both at the spillways and over the top of the dam, and since the depth of flow overtopping the dam, (2.9 feet maximum) and the duration of flow over the dam (5.3 hours), are substantial, serious damage by erosion due to overtopping of the dam is likely. The extent of these damages is not predictable, however, there is the possibility that they could result in failure of the dam.

f. References. Procedures and data for determining the probable maximum flood, the 100-year frequency flood, and the discharge rating curve for flow passing the spillways and dam crest are presented on Pages B-1 and B-2 of the Appendix. Listings of the HEC-1 (Dam Safety Version) input data for both the probable maximum flood and the 100-year frequency flood are shown on Pages B-3 and B-4 of the Appendix. A copy of the computer output table entitled "Summary of Dam Safety Analysis" is presented on Page B-5 and the inflow and outflow hydrographs for the probable maximum flood are shown on Page B-6 of the Appendix. Rating curves for the spillways are presented on Plate 5 and area-storage curves for the reservoir are shown on Plate 6.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No construction data relating to the structural stability of the dam are known to exist.

c. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to a representative of the Owner, no records are kept of the lake level, spillway discharge, dam settlement, or seepage.

d. Post Construction Changes. With the exception of construction of a second seepage cutoff along the upstream side of the dam and lowering the spillway crest to rock, both of which were undertaken in about 1976, it was reported that no additional post construction changes have been made or have occurred which would affect the structural stability of the dam.

e. Seismic Stability. The dam is located within a Zone II seismic probability area, and an earthquake of the magnitude predicted for this area is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicated that the spillways (principal plus emergency) are capable of passing lake outflow of about 1,077 cfs without the level of the lake exceeding the low point in the top of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicated that for storm runoff of probable maximum flood magnitude, the lake outflow would be of the order of 7,002 cfs, and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 565 cfs.

Items noticed during the inspection that could adversely affect the safety of the dam include lack of adequate erosion protection at the spillways and along the upstream face of the dam.

Within the scope of this investigation it is not possible to conclude if the leakage that the reservoir is experiencing poses a hazard to the safety of the dam. There is a possibility that loss of water from the lake can lead to a piping condition (progressive internal erosion) if the location of the leak or leaks is through the dam structure. Since there is evidence, two springs believed to be charged by the lake were observed downstream of the dam, that an aquifer exists in the immediate area of the dam, the possibility of a piping condition cannot be discounted.

Seepage and stability analyses of the dam were not available for review and therefore no judgment could be made with respect to the structural stability of the dam.

b. Adequacy of Information. Due to lack of design and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessment of the

hydrology of the watershed and capacities of the spillways were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The items concerning the safety of the dam noted in Paragraph 7.1a and the remedial measures recommended in Paragraph 7.2 should be accomplished within a reasonable period of time.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. Seismic Stability. The dam is located within a Zone II seismic probability area, and an earthquake of the magnitude predicted for this area is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Based upon criteria set forth in the recommended guidelines, alterations to the design of the dam should be made in order to pass lake outflow resulting from a storm of probable maximum flood magnitude.

(2) Obtain the necessary soil data and perform dam seepage and stability analyses in order to determine the structural stability of the dam for all operational conditions. Seepage and stability analyses should be performed by a qualified professional engineer experienced in the design and construction of dams.

b. Operations and Maintenance (O & M) Procedures. The following O & M Procedures are recommended:

(1) Provide some means of preventing excessive leakage from the reservoir in order that the lake may be operated as intended. In this respect, it is important that leakage (seepage) at the dam be controlled in order to prevent piping (progressive internal erosion) which could result in failure of the dam.

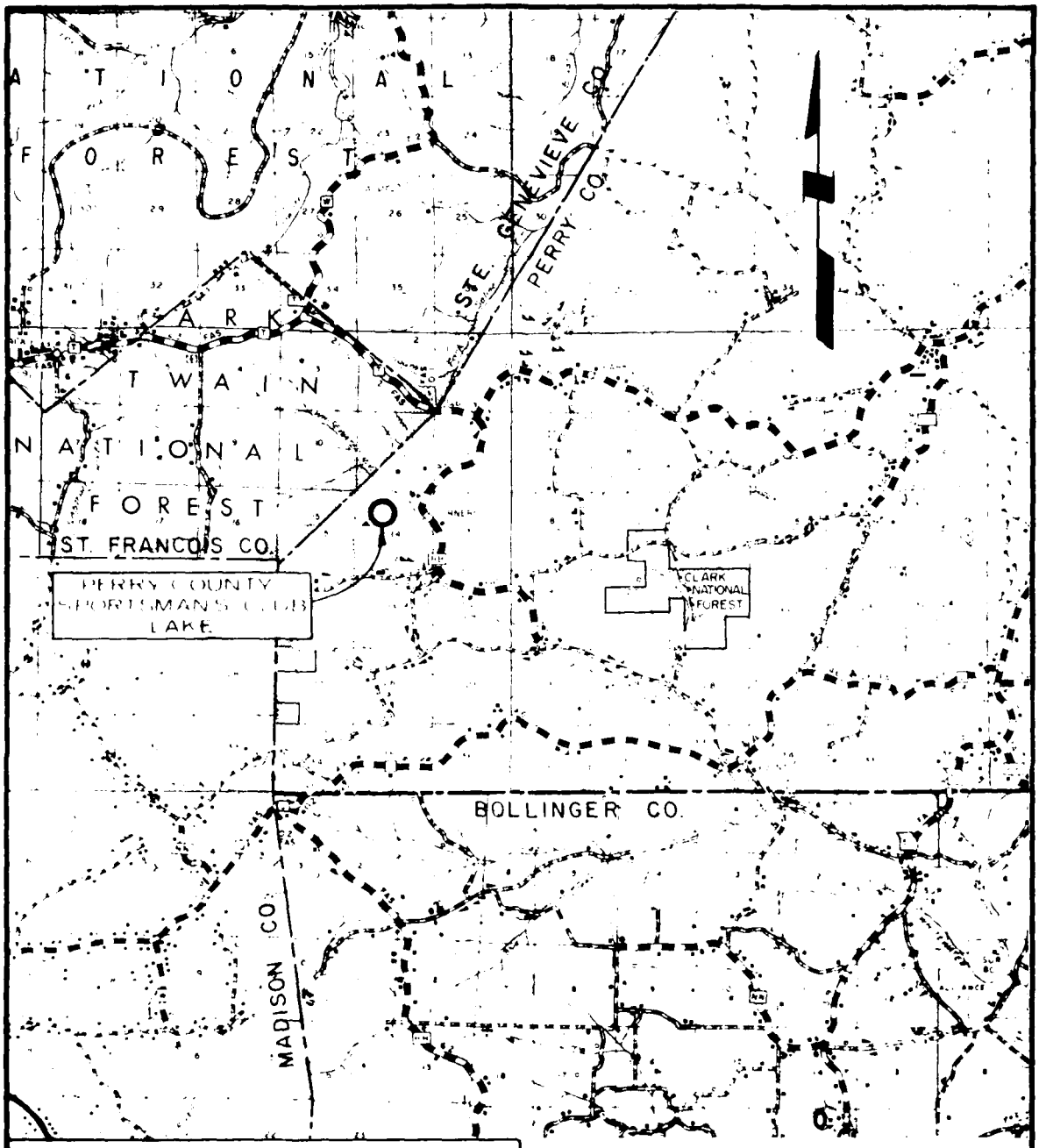
(2) Restore the eroded areas of the spillway channel and provide some form of protection particularly along the dam side of the outlet channel in order to prevent future erosion by spillway flows.

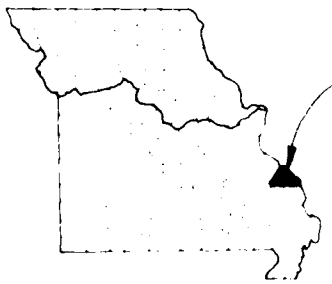
(3) Provide some form of slope protection other than grass for the upstream face of the dam at and above the normal waterline in order to prevent erosion. A grass covered slope is not considered adequate protection to prevent erosion by wave action or by a fluctuating lake level.

(4) Maintain the plant cover on the dam at a height that will not conceal animal burrows or hinder inspection of the dam. Voids created by burrowing animals can provide pathways for lake seepage that can lead to piping and possibly failure of the dam.

(5) Provide maintenance of all areas of the dam and spillways on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

(6) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.





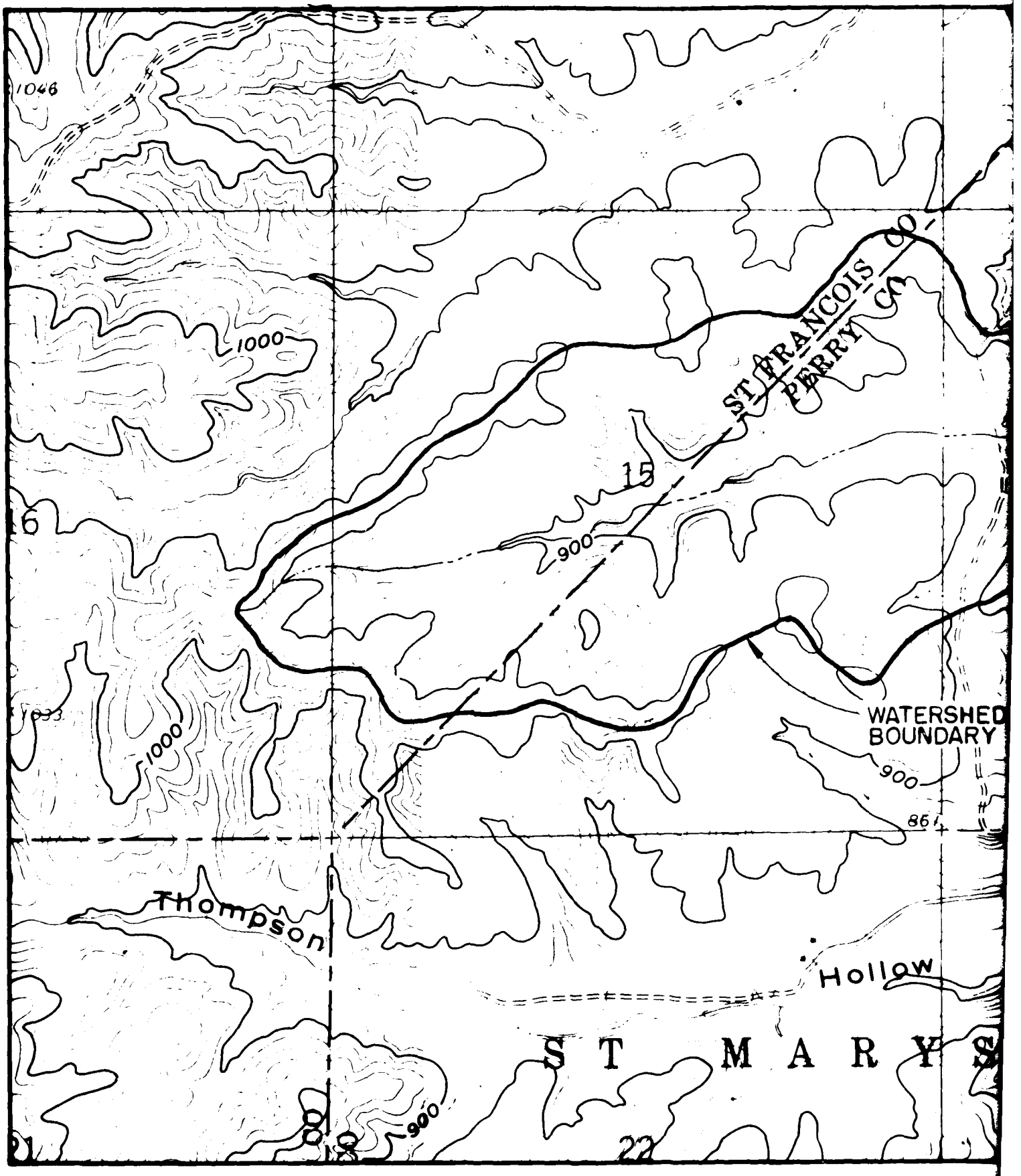
LOCATION MAP

PERRY COUNTY
SPORTSMAN'S CLUB LAKE

1 0 1 2 3 4
SCALE (MILES)

REGIONAL VICINITY MAP

PLATE 1


1046
1000
ST FRANCOIS
PERRY CO.
15
16
900
1000
WATERSHED
BOUNDARY
900
Thompson
Hollow
ST MARY'S
900
21
22

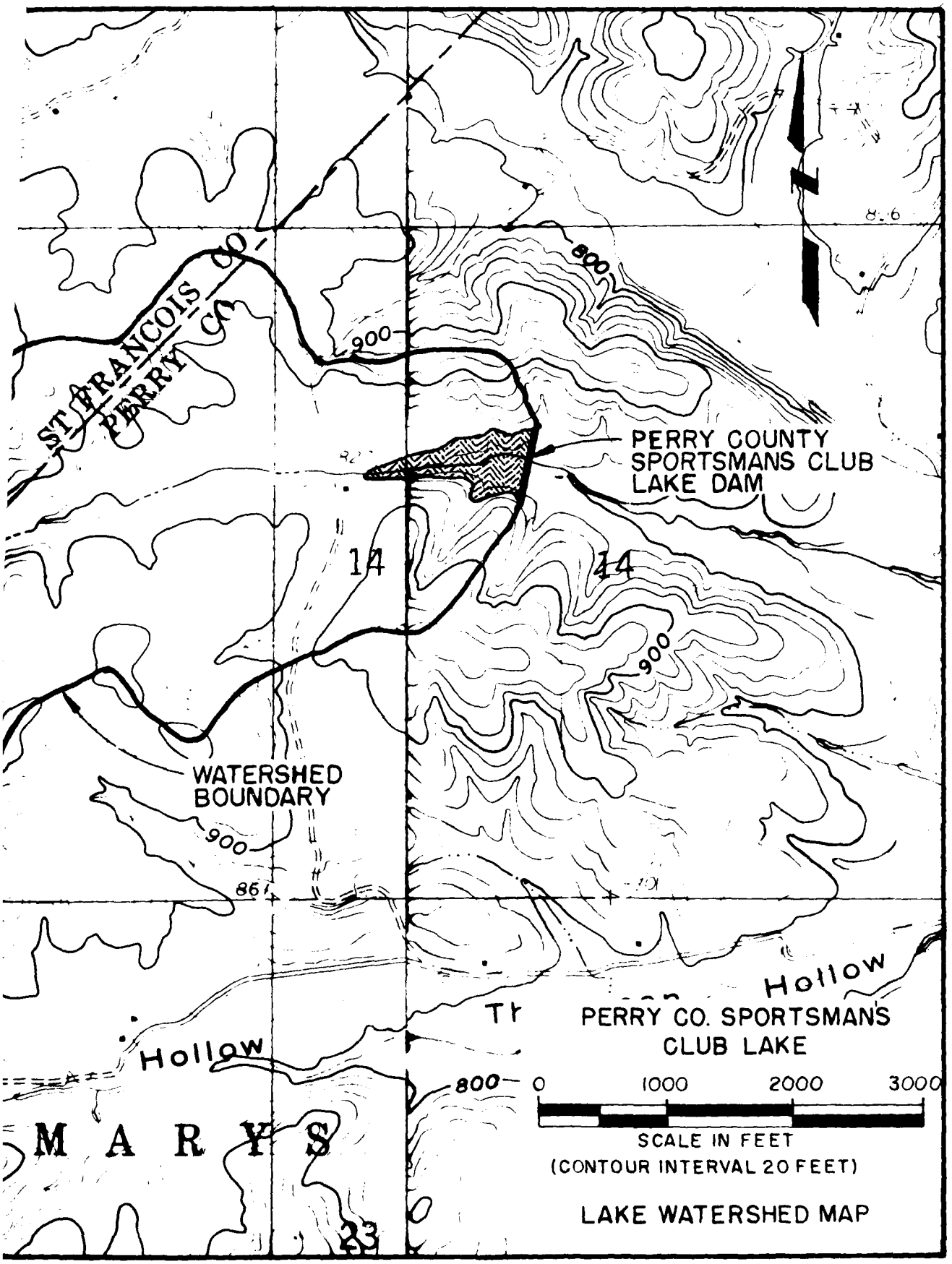
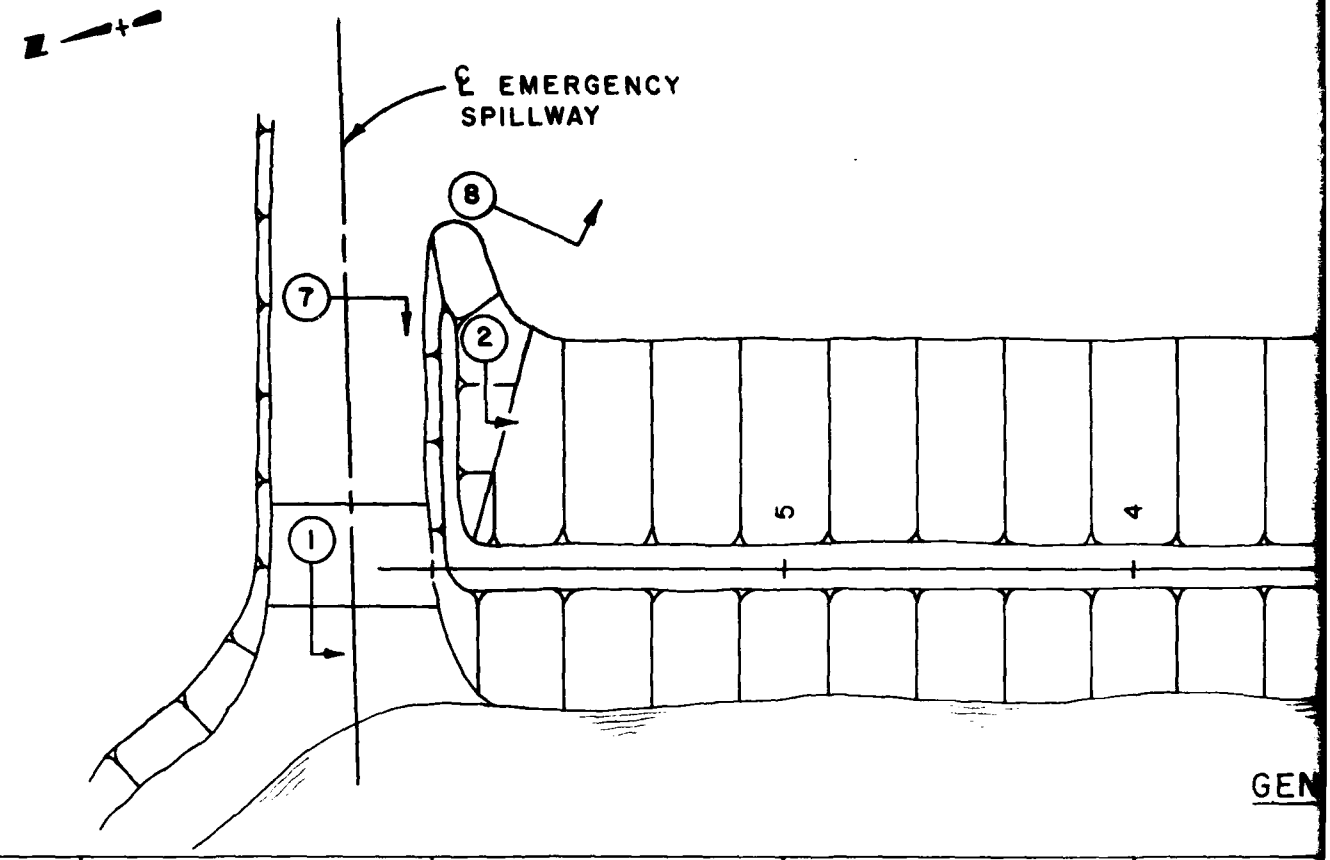
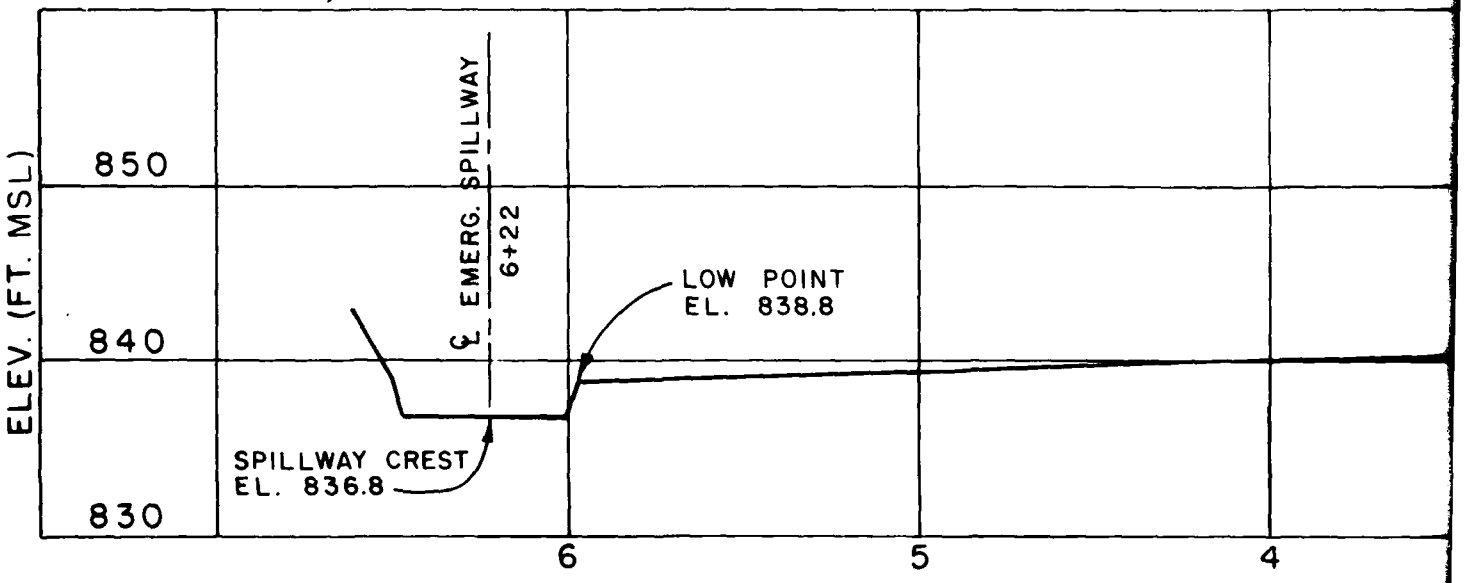

ST FRANCOIS
PERRY CO
800
900
PERRY COUNTY
SPORTSMANS CLUB
LAKE DAM
14
14
900
WATERSHED
BOUNDARY
900
Hollow
PERRY CO. SPORTSMANS
CLUB LAKE
Hollow
800
0
1000
2000
3000
SCALE IN FEET
(CONTOUR INTERVAL 20 FEET)
LAKE WATERSHED MAP
M A R Y S
23

PLATE 2

NOTE:



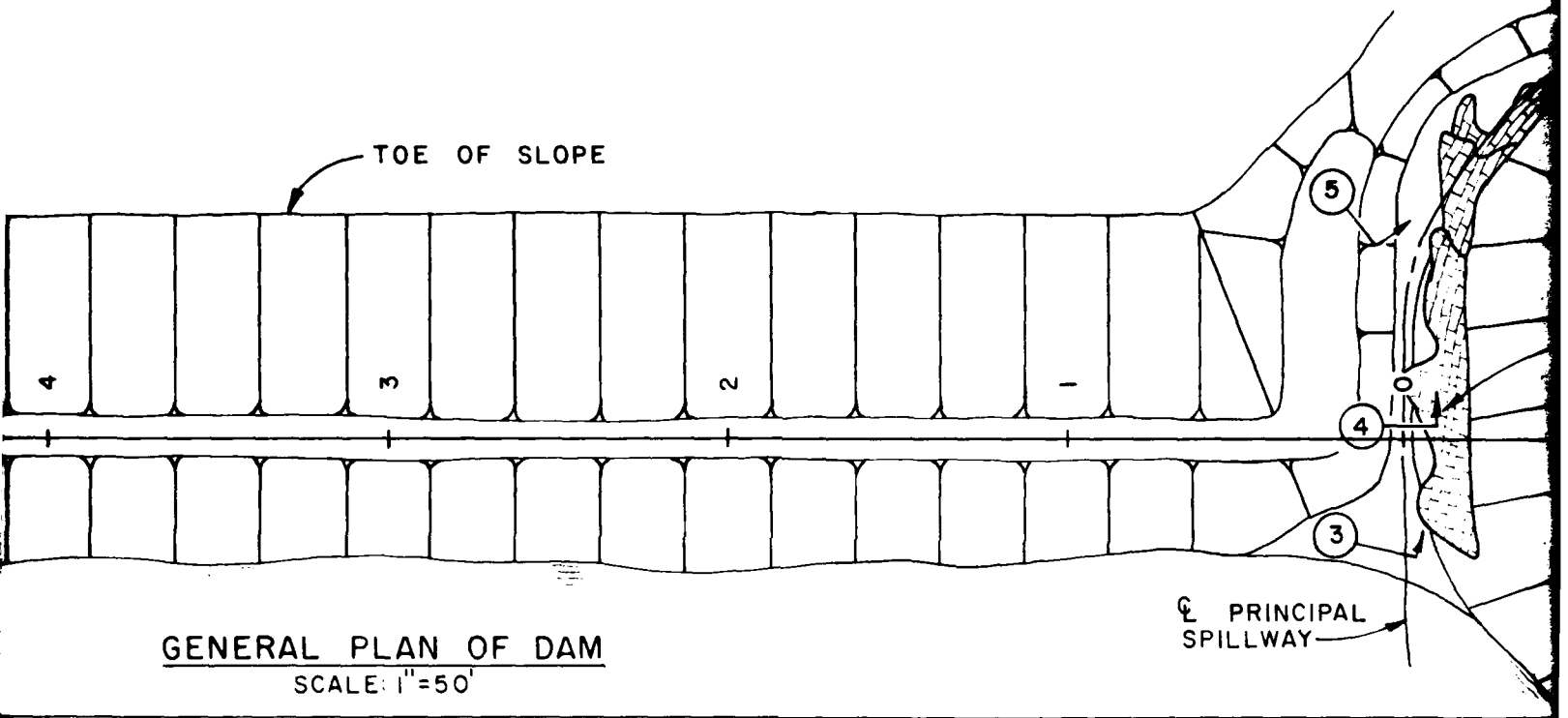
GEN



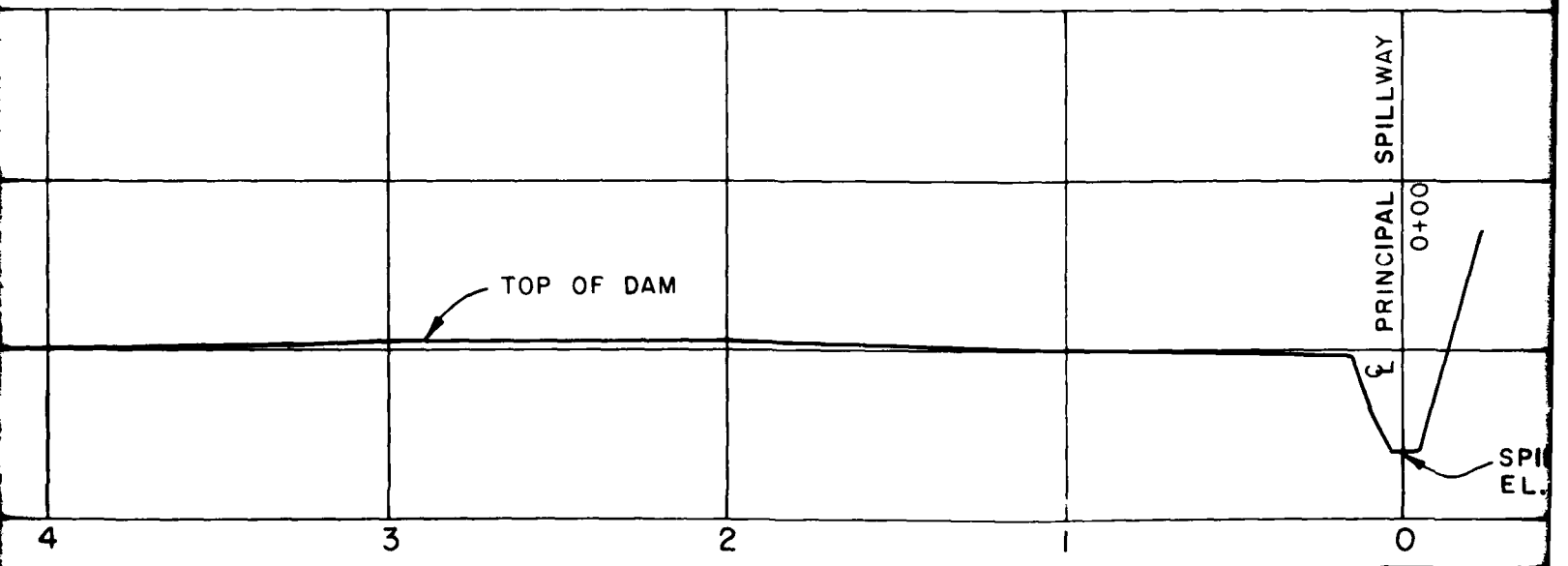
PROFI
SCAL

6
PHOTO LOCATION & KEY
(SEE APPENDIX A)

NOTE: LOCATIONS OF PHOTOS 9 & 10 (NOT SHOWN)
APPROX. 1,000' DOWNSTREAM OF DAM.



GENERAL PLAN OF DAM
SCALE: 1"=50'

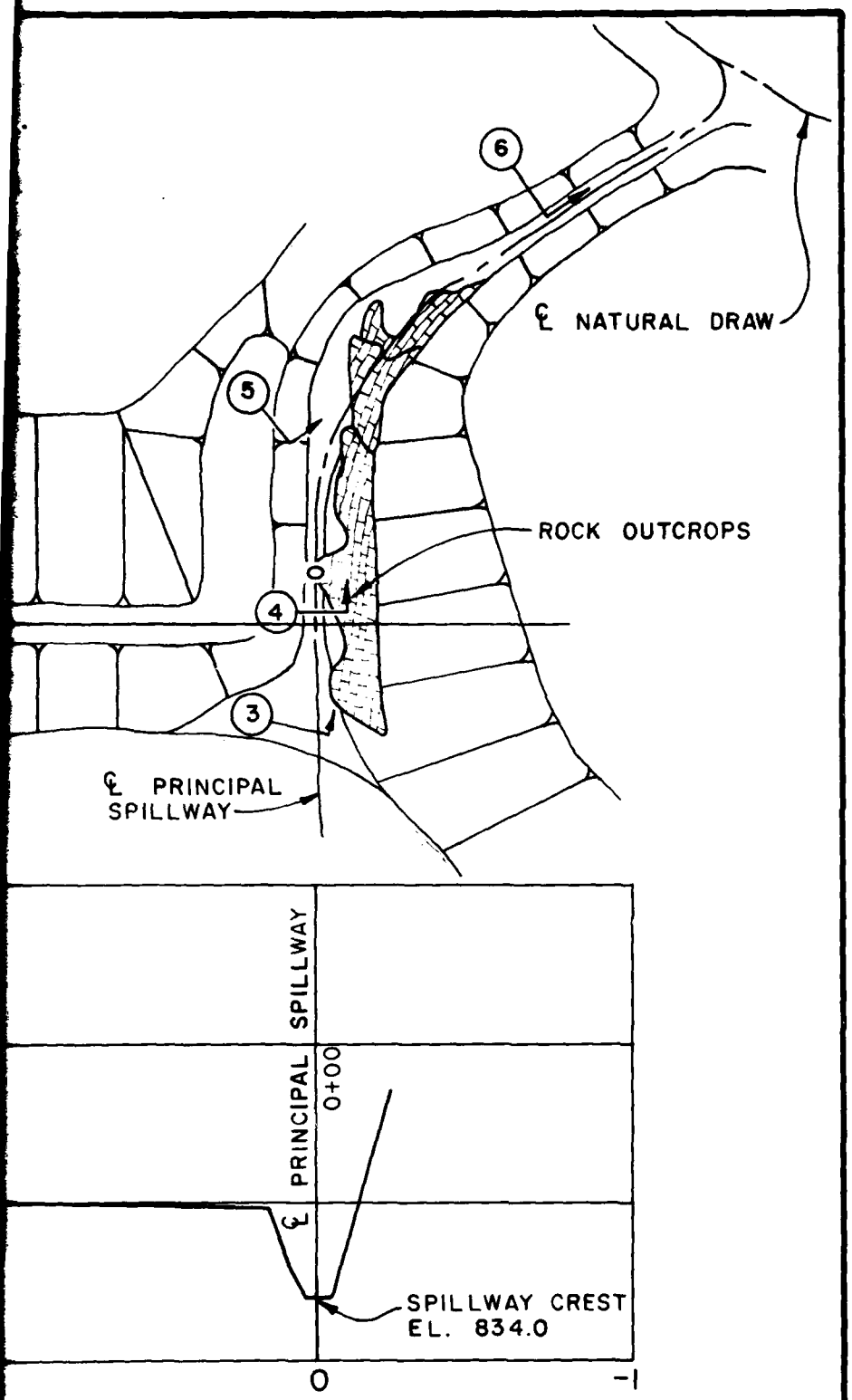


PROFILE DAM CREST
SCALES: 1"=10'V., 1"=50'H.

PERF

DAM

Horner &

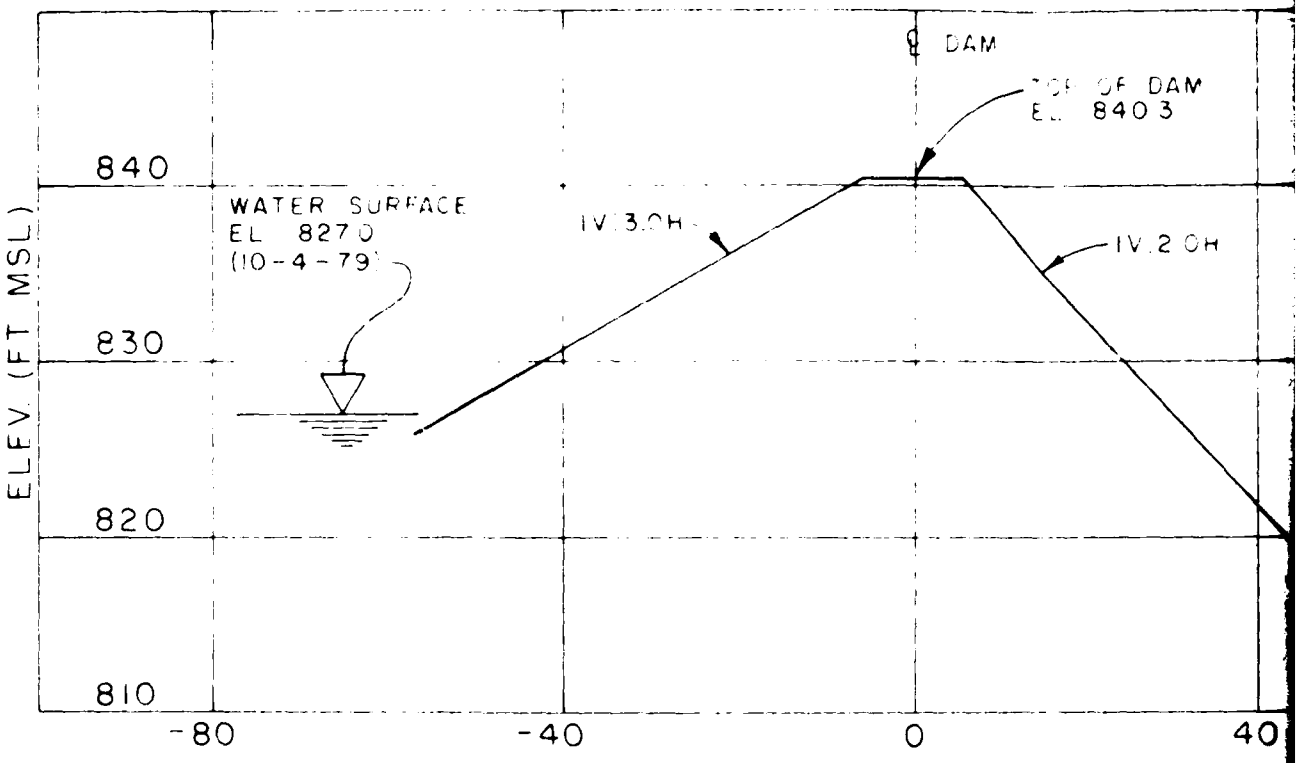


PERRY CO. SPORTSMAN'S CLUB LAKE

DAM PLAN & PROFILE

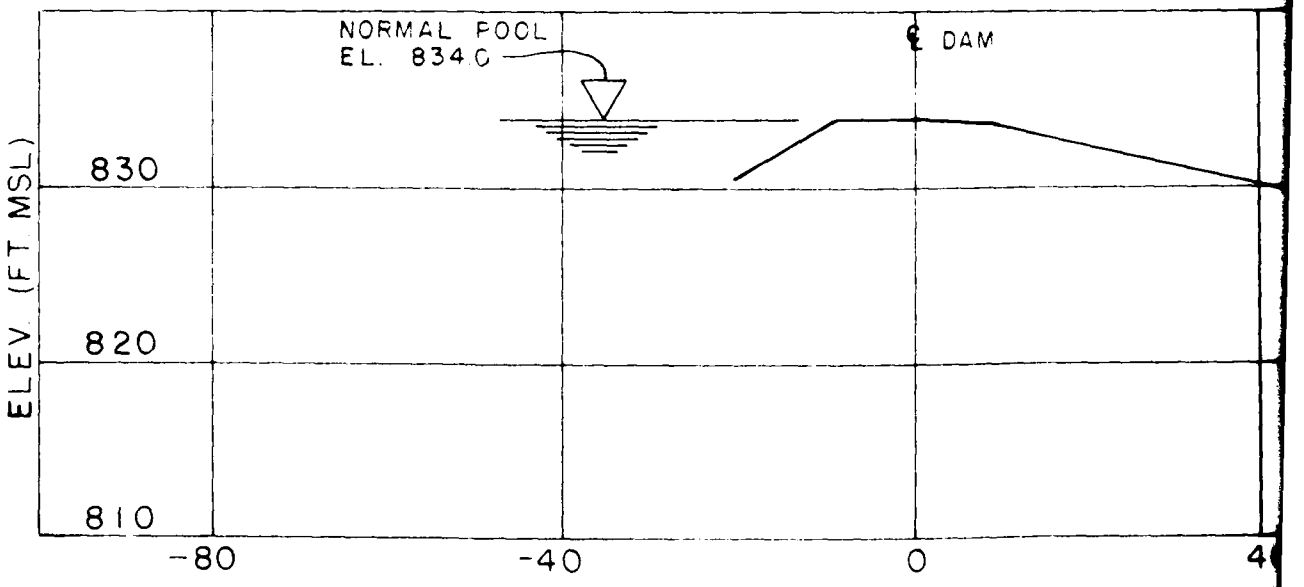
Horner & Shifrin, Inc. Nov. 1979

PLATE 3



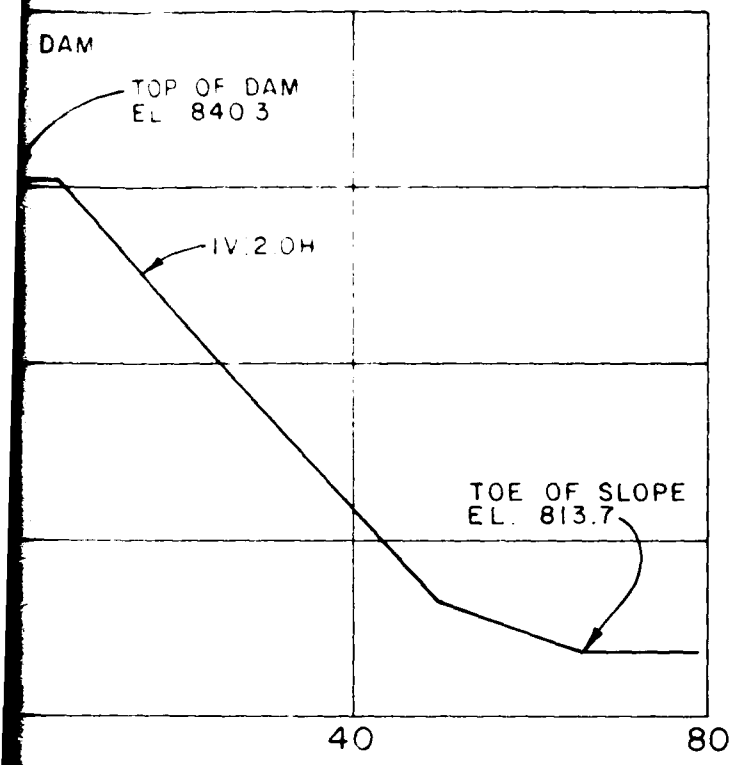
DAM CROSS SECTION STA 3+30

SCALES: 1"=10' V., 1"=20' H



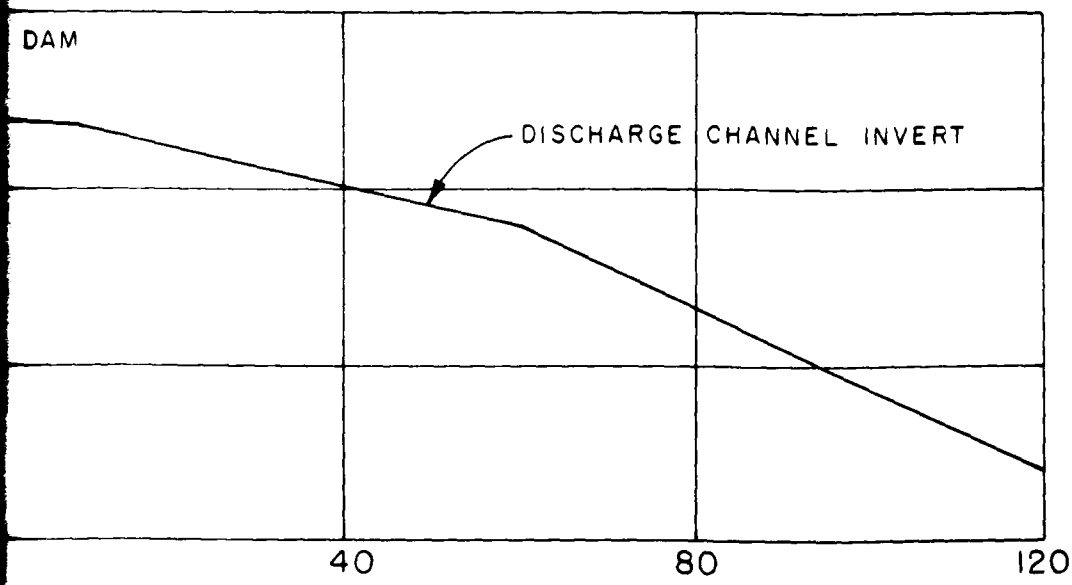
PROFILE SPILLWAY ℄

SCALES: 1"=10' V., 1"=20' H.



STA 3+30

20'H.



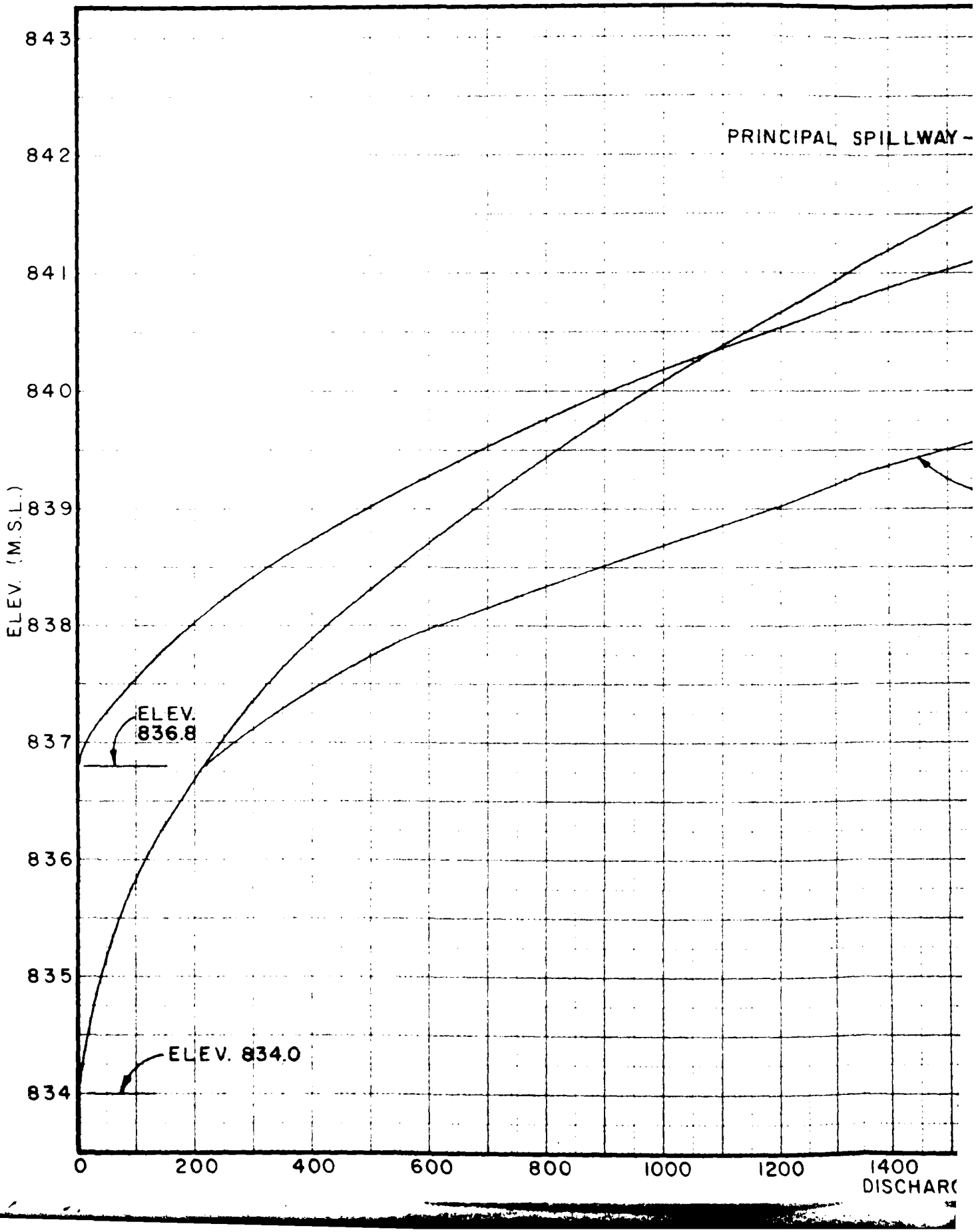
AY ℄

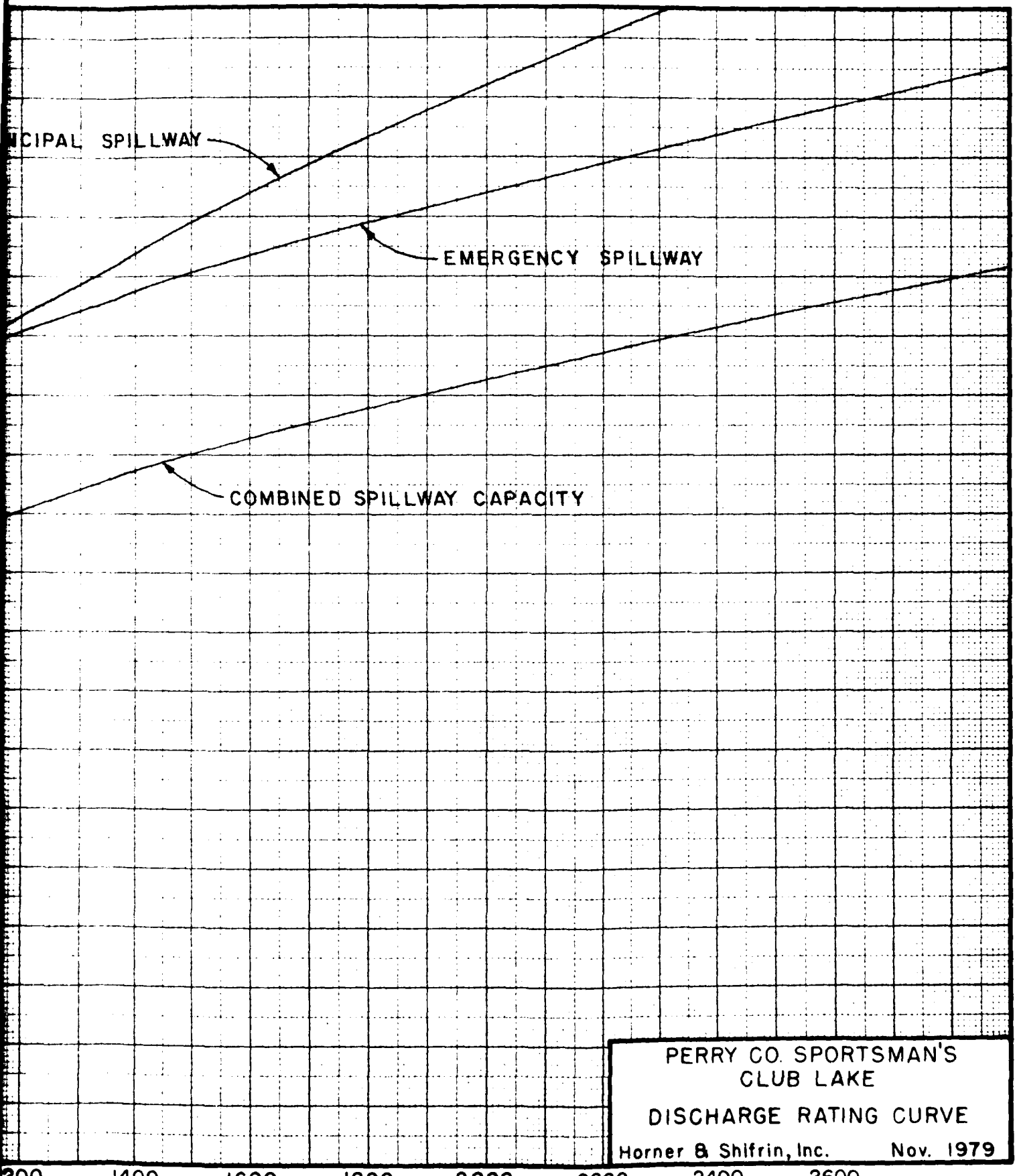
20'H.

PERRY CO. SPORTSMAN'S CLUB LAKE
DAM CROSS-SECTION & SPILLWAY PROFILE
Horner & Shifrin, Inc Nov 1979

2

PLATE 4


843
842
841
840
839
838
837
836
835
834
ELEV. (M.S.L.)
PRINCIPAL SPILLWAY -
ELEV. 836.8
ELEV. 834.0
0
200
400
600
800
1000
1200
1400
DISCHARG

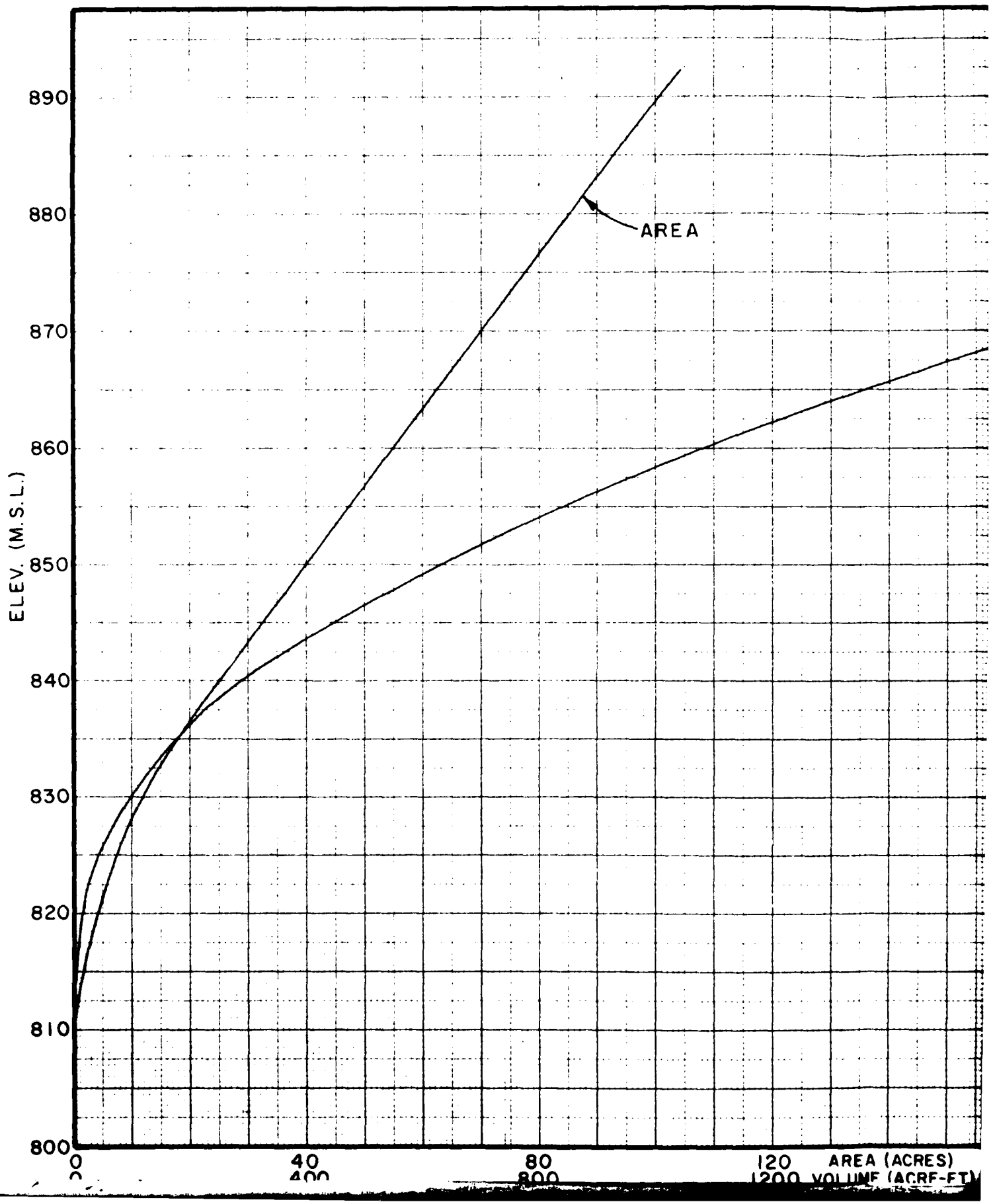


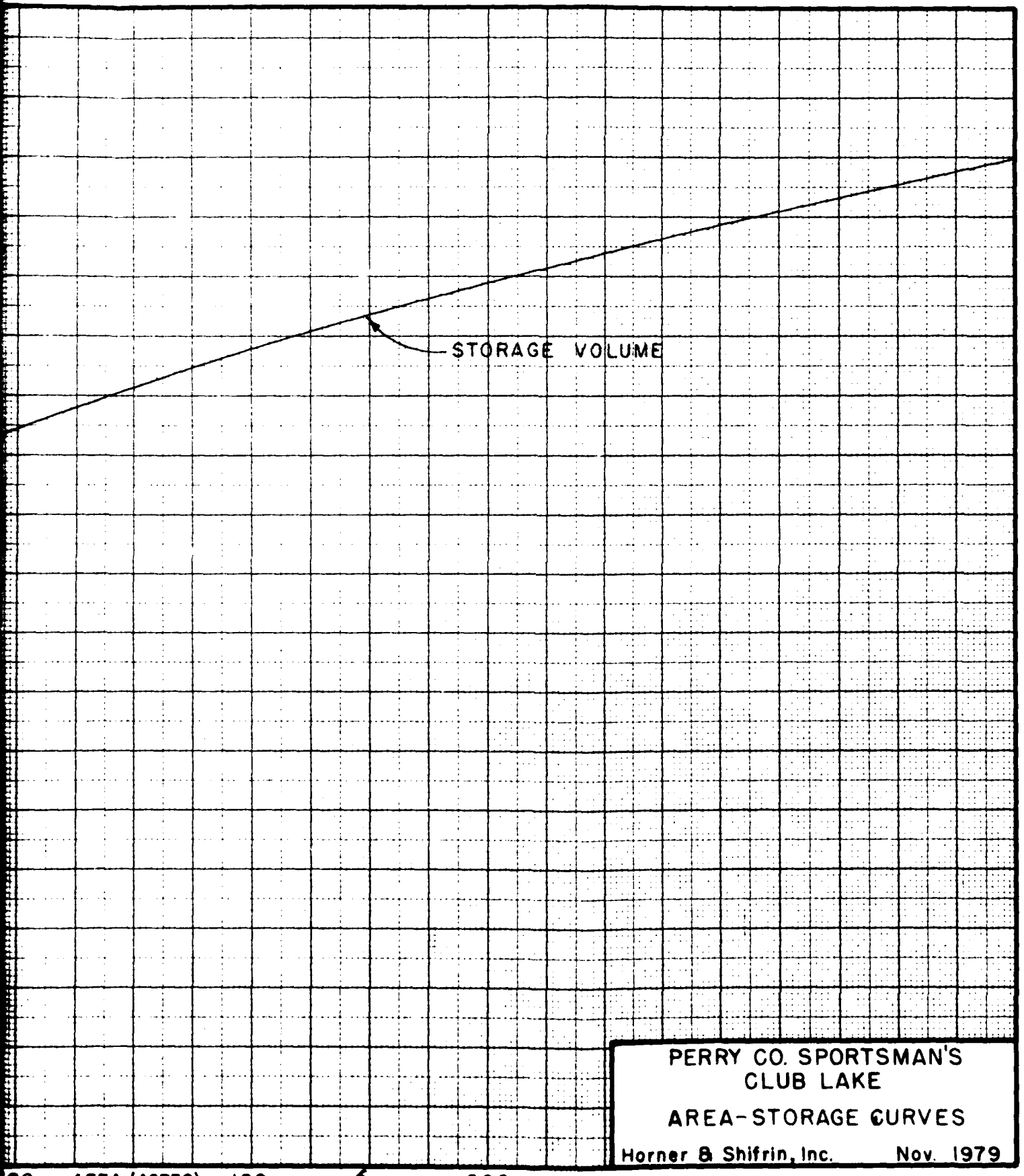
PERRY CO. SPORTSMAN'S CLUB LAKE

DISCHARGE RATING CURVE

Horner & Shifrin, Inc. Nov. 1979

PLATE 5


ELEV. (M.S.L.)
890
880
870
860
850
840
830
820
810
800
AREA
0
40
80
120
AREA (ACRES)
400
800
1200
VOLUME (ACRE-FT)



PERRY CO. SPORTSMAN'S CLUB LAKE

AREA-STORAGE CURVES

Horner & Shifrin, Inc. Nov. 1979

PLATE 6

ENGINEERING GEOLOGIC REPORT ON SPORTSMEN'S CLUB LAKE SITE
PERRY COUNTY, MISSOURI

LOCATION: NE¼ SW¼ NW¼ sec. 14, T. 34 N., R. 8 E., (Parker Lake).

SUITABILITY: Poor from the geologic aspect of water retention.

GEOLOGIC SETTING:

Bedrock exposed in the valley on the south side consists of the Gasconade dolomite. For the most part, however, the region is underlain by the residuum of the overlying formation, the Roubidoux. This residuum, predominantly a silt-gravel mixture makes up most of the watershed and reservoir area. Weathering of both the Roubidoux and Gasconade has produced a valley that is filled with gravelly silt. Soils on the hillslopes are made up of silty clay, again mixed with an abundance of stones. Typically, the silty gravel in the floodplain is moderately to highly permeable as evidenced by the poorly defined stream channel. Sustained stream flow is inadequate to erode and maintain a clean and well defined stream channel. Absence of terraces on the valley floor further notes that the stream is active only when intense storms occur. Lack of sustained flow is evidenced also by the absence of fine textured soils, lack of segregation of these soils into lenses of silts, sands and clays and absence of soil accumulated at the hillslope-floodplain contact.

RECOMMENDATIONS:

It is most important that no sealant procedures be undertaken without a thorough foundation investigation of the dam and lake as it exists at present. However, even after thorough investigation and controlled remedial procedures followed in attempts to seal the lake, the opportunity for maintaining a permanent pool level is perhaps no greater than 50 percent.

First step recommended is to explore the characteristics of the foundation, at least to depths of 20 feet. This can best be done with a backhoe or backhoe and dozer combination. It is of importance to note both if there are clay lenses present in the gravels and if so the persistence of these lenses. If the material that is present in the lower valley floor even at depths, is poorly sorted and predominantly a mixture of boulders, gravels and sands with little fine textured soils, that is clay, then the possibility of sealing the lake would be remote.

It is hoped that seepage is passing under the dam and that the backhoe exploration will confirm this hope. If this is the characteristic of the site then a deep core trench could be constructed at the upstream toe of the dam. This trench backfilled with clay would intercept seepage under the dam and retain water in the lake. However, if backhoe trenches reveal permeable gravel deposits at depths of 20 feet or more, the opportunity to successfully construct an intercepting core to retard seepage is nil. It is also suggested that several exploration pits be [illegible] within the reservoir area. The intent of this would be to reveal the characteristics of the subsoil, that is stream alluvial deposits, within the reservoir region to ascertain if leakage is occurring vertically throughout the lake area.

Again it would be important to examine the characteristics of the subsoil or alluvial deposits to note if there are fine textured materials present and how these deposits were formed. If possible, these holes could be partially filled with water to determine the rate of seepage from the exploration pits.

If conclusions are that the leakage is occurring throughout the reservoir, the only possible way of sealing the lake is to pad the floor of the lake. This of course requires borrowing the padding material from areas adjoining the lake and spreading a dirt pad of 2 feet or more in thickness across the entire lake floor. Such remedial procedures have limited chance of success and are costly. However, sealing of the reservoir floor by degrees could be considered, that is, a dirt pad placed for a short distance upstream of the dam, the extent of padding being more regulated by the amount of funds available rather than by any geologic criteria. Observation as to the success of this pad could be made for perhaps a year or more. If padding is successful and more funds become available, additional padding further upstream could then be considered. Over a period of years a lake at least partially successful could perhaps be obtained with using this procedure.

James R. Williams
Geologist and Chief
Engineering Geology Section
Missouri Geological Survey
August 11, 1971

APPENDIX A

INSPECTION PHOTOGRAPHS

NO. 1: UPSTREAM FACE OF DAM

NO. 2: DOWNSTREAM FACE OF DAM

NO. 3: CREST OF PRINCIPAL SPILLWAY (LOOKING DOWNSTREAM)

NO. 4: SPILLWAY CHANNEL (LOOKING DOWNSTREAM FROM CREST)

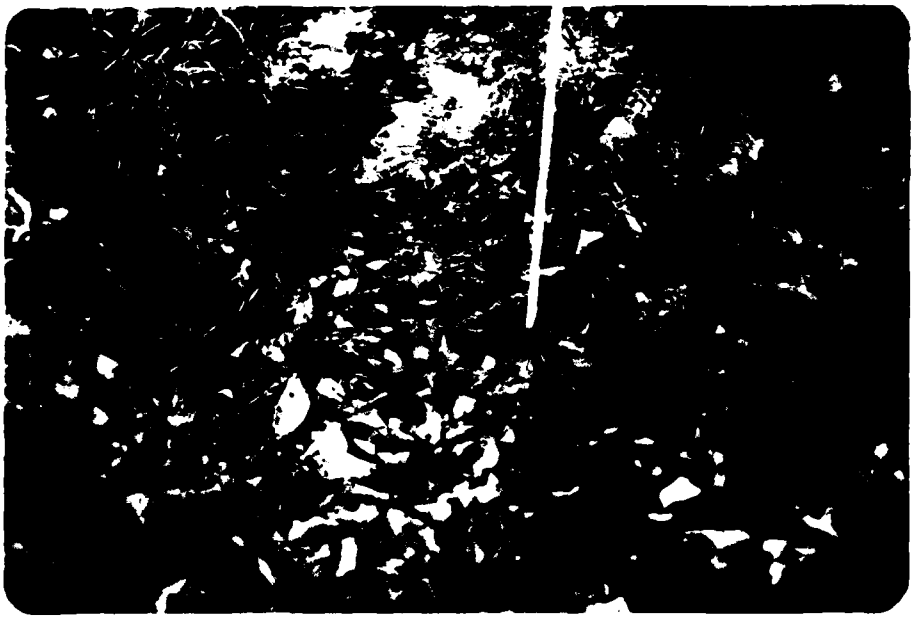
NO. 5: ROCK LEDGES IN SPILLWAY CHANNEL

NO. 6: JUNCTION OF SPILLWAY CHANNEL AND DRAW

NO. 7: CREST OF EMERGENCY SPILLWAY (LOOKING UPSTREAM)

NO. 8: BORROW AREA DOWNSTREAM OF DAM

NO. 9: SEEPAGE FLOW FROM SPRING BELOW RIGHT SIDE OF DAM



NO. 10: SEEPAGE FLOW FROM SPRING BELOW CENTER OF DAM

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1979, Modified 26 February 1979) program was used to develop inflow and outflow hydrographs and the overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 27.9 inches, from Hydrometeorological Report No. 33. The precipitation data used in the analysis of the 1 percent (100-year frequency) flood was provided by the St. Louis District, Corps of Engineers.

b. Drainage area = 0.72 square miles = 461 acres.

c. SCS parameters:

Lag time = 0.28 hours

Soil Group D = 100 percent

Soil type CN = 88 (AMC III, PMF condition)

= 75 (AMC II, 100-yr. condition)

Lag Time = 0.6 Tc (SCS Method)

Time of Concentration (Tc) = $\left(\frac{11.91}{\frac{H}{L}}\right)^{0.385}$

Where; T_c = Travel time of water from hydraulically most distant point to point of interest, hours

L = Length of longest watercourse, miles

H = Elevation difference, feet.

2. The principal and emergency spillway sections consist respectively of broad-crested, trapezoidal and dish-shaped sections for which conventional weir formulas do not apply.

a. Spillway crest section properties (area, a, and top width, t) were computed for various depths, d.

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth was computed as $Qc=(\frac{a^3}{t})^{0.5}$ for the various depth, d. Corresponding velocities (v_c) and velocity heads (h_{vc}) were determined using conventional formulas.

c. Static lake levels corresponding to the various values passing over the spillway were computed as critical depths plus critical velocity head ($d_c + h_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

d. The discharges for the principal and emergency spillways for equal elevations were summated for entry on the Y4 and Y5 cards.

3. The profile of the dam crest between the principal spillway and emergency spillway is irregular and flow over the dam crest cannot be determined by conventional weir formulas. Crest length and elevation data for the dam crest proper were entered into the HEC-1 program on the $L and the $V cards. The program computes internally the flow over the dam crest and adds this flow to the flow over the principal and emergency spillway as entered on the Y4 and Y5 cards.

```
A1        ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2        HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF PERRY CO SPORTSMAN CLUB LAKE DAM
A3        RATIOS OF PMF ROUTED THROUGH RESERVOIR                              0
B     208        0        5
B1      5
J       1        5        1
J1    .23      .24      .25      .50      1.0                1
K       0   INFLOW
K1        INFLOW HYDROGRAPH                                  1.0                    1
M       1        2      0.72
P       0     27.0      102      120      130                  -1     -.08
T
W2               0.28
X    -1.0     -.10      2.0                                   1
K       1      DAM
K1        RESERVOIR ROUTING BY MODIFIED PULS
Y                                    1        1
Y1      1                                                    161.6      -1
Y4  834.0    834.7    835.4    836.1    836.7    837.4    838.0    839.3    840.7    842.0
Y4  843.4    844.8     44.5    122.6    234.9      379      614     1367     2507     3952
Y5      0     21.4
Y5   5202     6984     25.3     54.4     84.7
$A      0     20.2      840      860      880
$E  834.02     834
$S    834
$D  835.0                           245      573      573      573      573      573
$L      0       90      150    840.3    840.6      841      842      842      843
$V  838.8    837.3    839.6
K      99
```

```
A1        ANALYSIS OF DAM OVERTOPPING USING 100YR FLOOD
A2        HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF PERRY CO SPORTSMAN CLUB LAKE DAM
A3        100YR FLOOD ROUTED THROUGH RESERVOIR
B      286        0        5                                                          0
B1       5
J        1        1        1
J1     1.0      .10      .15      .20      .25      .30     0.40      .50     1.00
K        0   INFLOW                                           1
K1        INFLOW HYDROGRAPH
M        0        2     0.72                        1.0                          1
O      288
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .013     .013     .013     .013     .013     .013     .013     .013
O1    .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
O1    .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
O1    .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
O1    .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
O1    .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
O1    .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
O1    .013     .013     .013     .013     .024     .024     .024     .024     .024     .024
O1    .024     .024     .024     .024     .024     .024     .024     .024     .024     .024
O1    .024     .024     .031     .031     .031     .031     .031     .031     .049     .049
O1    .049     .049     .049     .049     .138     .138     .139     .262     .262     .544
O1    .813     .378     .262     .139     .138     .138     .049     .049     .049     .049
O1    .049     .049     .031     .031     .031     .031     .031     .031     .024     .024
O1    .024     .024     .024     .024     .024     .024     .024     .024     .024     .024
O1    .024     .024     .024     .024     .024     .024     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1    .007     .007     .007     .007     .007     .007     .007     .007
T                                                            -1      -75
W2             4.26
X     -1.0     -.15      2.0
K        1  [illegible]                                      1
K1        RESERVOIR ROUTING BY MODIFIED PULS
Y
Y1       1                                                161.5       -1
Y4   834.0    834.7    835.4    836.1    836.7    837.4    838.0    839.3    840.7    842.0
Y4   843.4    844.8
Y5       0     21.4     64.5    122.4    264.9      379      614     1367     2867     3952
Y5    5232     6764
$A       0     16.0     25.3     54.4     96.7
$E   804.2      834      840      840      840
$S     834
$D   836.4
$L       0       50      150      245      573      573      573      573      573
$V   838.8    839.3    839.8    840.3    840.8      841      842      843      845
K       99
```

SUMMARY OF DAM SAFETY ANALYSIS

RATIOS OF PMF

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	834.00	834.00	838.80
STORAGE	152.	162.	257.
OUTFLOW	0.	0.	1077.

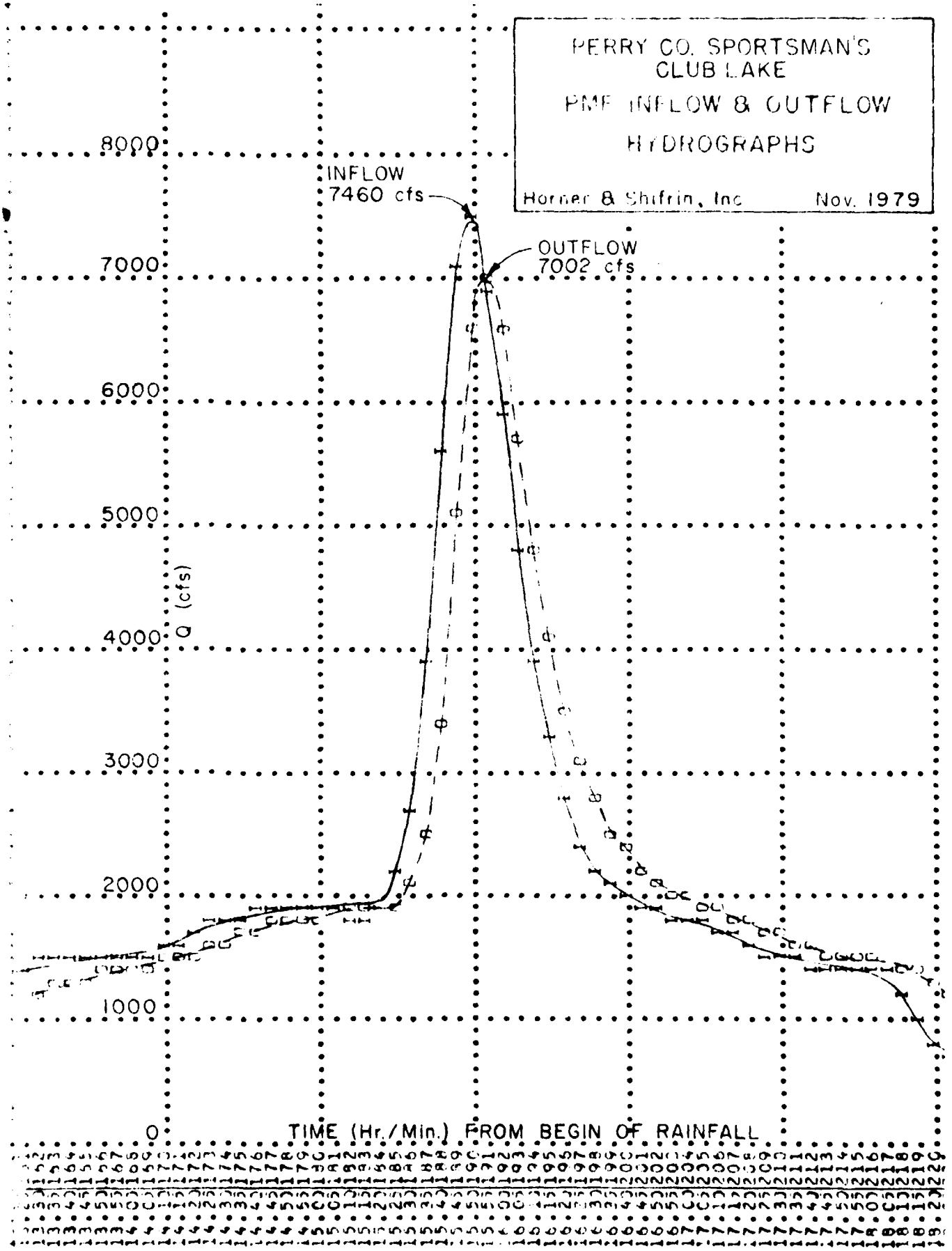
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.25	838.79	0.00	256.	1046.	0.00	16.08	0.00
.44	838.84	.04	256.	1102.	.17	16.00	0.00
.25	838.93	.13	260.	1155.	.33	16.04	0.00
.50	840.43	1.63	297.	2938.	1.50	16.00	0.00
1.00	841.69	2.85	329.	7002.	5.25	15.92	0.00

SUMMARY OF DAM SAFETY ANALYSIS

100 YR. FLOOD

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	834.00	834.00	838.80
STORAGE	162.	162.	257.
OUTFLOW	0.	0.	1077.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	838.09	0.00	241.	665.	0.00	15.75	0.00


PERRY CO. SPORTSMAN'S CLUB LAKE
PMF INFLOW & OUTFLOW HYDROGRAPHS
Horner & Shifrin, Inc
Nov. 1979
INFLOW 7460 cfs
OUTFLOW 7002 cfs
8000
7000
6000
5000
4000
3000
2000
1000
0
Q (cfs)
TIME (Hr./Min.) FROM BEGIN OF RAINFALL